* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to the color correction unit which changes an input color image signal into the control signal of the output unit with which the color reproduction range was restricted.
[0002]
[Description of the Prior Art]Generally the color reproduction range in the printer of an electrophotographying system, an ink-jet printer, etc., Since it is narrow compared with color reproduction ranges, such as television and a CRT display, many color correction methods corresponding to the case where the color reproduction range which an input color image has differs from the color reproduction range of an output unit conventionally have been proposed. For example, to JP,4-40072,A on uniform color space or a HVC color space (color space which consists of information about brightness, hue, and chroma saturation), It judges whether it is outside the color reproduction range of an output destination change, and, in outside a color reproduction range, the color correction method, wherein brightness and the chroma saturation with same hue correct and output to the greatest value is indicated. By JP,61-288690,A, when the color reproduction ranges of a power range system differ to an input system, hue is set constant a center [the white point on a chromaticity diagram], and the color image processing method carrying out the compression map of the point outside the color reproduction range of a power range system at the point in a color reproduction range is indicated.
[0003]
[Problem(s) to be Solved by the Invention]However, in the above conventional technologies, it is uniform color space etc. like a JP,4-40072,A statement first, If the size and shape of a color reproduction range differ from each other greatly like a CRT monitor and a hard copy, for

example when compressing chroma saturation, maintaining hue and brightness in order to change into the control signal of the output unit with which the color reproduction range was restricted, For example, there is a problem of ****, such as thing red (Red) with low brightness which cannot reproduce an output unit, and blue (Blue) with high brightness, being lost. By the technique of compressing brightness and chroma saturation toward a white point etc. uniformly, and the technique compressed into a color difference minimum direction, like a JP,61-288690,A statement. In natural pictures, such as a photograph, there was a problem which the chroma saturation of a highlight part is too high, or crushing of high saturation produces about a certain color. In [are made in order that this invention may solve the problem of the above conventional technologies, and] claim 1, In the convert colors between the color picture output devices from which the size of a color reproduction range differs, In [make into a technical problem to provide the color correction unit which can carry out color correction in which crushing of high saturation includes matching of few color reproduction ranges, and] claim 2, In the convert colors between greatly different color picture output devices, the size and shape of the color reproduction range make it the technical problem to provide the color correction unit which can carry out color correction including desirable matching of a color reproduction range.

[0004]

[Means for Solving the Problem]In order to solve an aforementioned problem, the color correction unit according to claim 1, In a color converter which changes color image information in arbitrary color picture output devices into a control signal of arbitrary color picture output devices with which color reproduction ranges differ, As opposed to a lightness converting part which performs lightness converting processing which sets a brightness range relatively, and a color unreproducible even if it performs lightness converting processing, It is based on brightness after said lightness converting processing corresponding to the highest chroma saturation for every hue of a generating picture device used as a target of color matching, Crushing of high saturation enabled it to carry out color correction including matching of few color reproduction ranges by having a convert-colors part which controls a direction compressed for every hue according to brightness, and is compressed to a color in a color reproduction range. In a color converter which changes color image information in color picture output devices with the arbitrary color correction unit according to claim 2 into a control signal of arbitrary color picture output devices with which color reproduction ranges differ, As opposed to a lightness converting part which performs lightness converting processing which sets a brightness range relatively, and a color unreproducible even if it performs lightness converting processing, It is based on brightness after said lightness converting processing corresponding to the highest chroma saturation for every hue of a generating picture device of both sides which do color matching, It enabled it to carry out color correction including

desirable matching of a color reproduction range by having a convert-colors part which controls a direction compressed for every hue according to brightness, and is compressed to a color in a color reproduction range.

[0005]

[Embodiment of the Invention]Hereafter, an embodiment of the invention is concretely described using a drawing. Drawing 1 is an explanatory view of the embodiment at the time of making into input color space the CIELAB color space which is a typical color space. When a CIELAB color space is made into input color space so that it may illustrate, a CIELAB color space is divided into a solid figure (here cube) of the same kind. And in order to calculate the output value P which is an input and which coordinates (Lab value) can set, a cube including the coordinates of said input is chosen and linear interpolation is carried out based on the output value on the peak of eight points of the this chosen cube set up beforehand, and the position (distance from each peak) in said cube of said input. Here, when an input value is a control signal of 4 color printer, the output value P is equivalent to C, M, Y, and a K-value, respectively. Drawing 2 is a block lineblock diagram of the color correction unit in which a 1st embodiment of this invention is shown. The color reproduction range storage parts store 201 remembered the color reproduction range data (the brightness L, the maximum chroma saturation C to the hue H) of the printer to be in drawing 2 (ROM1), 202 is the peak output value storage parts store (ROM2) which memorized the control signal (C, M, Y, K) of the output unit corresponding to each peak on input color space, these color reproduction range data and peak output values are determined a priori, and each storage parts stores 201 and 202 are made to memorize them. 203 is an interpolation processing section and the control signal C, M, and Y of the printer in the peak output value storage parts store 202 and K are referred to based on an input signal at the time of color correction execution, It consists of the treating part 204 for C which carries out interpolating calculation of C, the treating part 205 for M which carries out interpolating calculation of M, the treating part 206 for Y which carries out interpolating calculation of Y, and the treating part 207 for K which carries out interpolating calculation of K.

[0006]Based on the maximum brightness (it becomes a color of paper) and the minimum brightness of a printer, 208, It is a lightness converting (L compression) part which carries out compression processing of the brightness ingredient (L^*) of an input picture signal, 209 is a convert-colors (compression) part which carries out compression processing to the color in a color reproduction range to a still unreproducible color after setting a brightness range relatively, and 210 is CPU which controls this whole color correction unit. The color correction unit constituted as mentioned above operates as follows. First, an input picture signal (referred to as Lab in this embodiment), In the lightness converting (L compression) part 208, compression processing of the brightness ingredient (L^*) of an input picture signal like the

following formula which made Lwhite and Lblack the maximum brightness (white point) of a printer and the minimum brightness (black point) is carried out.

$L^*=L^*x(Lwhite -Lblack) /100+Lblack$, however Lwhite : The maximum brightness of a printer (white point)

Lblack : the minimum brightness (black point) of a printer ... (1)

A compression means is not this limitation although linearity is compressed as an example in this example of an embodiment. Thus, the lightness value (L^*) of the input picture signal by which brightness compression was carried out in the lightness converting (L compression) part 208 is sent to the convert-colors (compression) part 209 with a chromaticity value (a^*b^*), and is changed into the brightness L, the hue H, and the information on the chroma saturation C as follows.

brightness: -- L chroma saturation: -- $C;(a^2 10b^2)^{0.5}$ hue: -- H=atan2(b, a)x180/pi however, the time of a=b=0 -- the time of H= 0 and H< 0 -- H=3600H ... (2)

the color reproduction range data (the brightness L.) of the printer which the convert-colors (compression) part 209 has in this brightness L, the hue H, and the information and the color reproduction range storage parts store 201 (ROM1) of the chroma saturation C here When the maximum chroma saturation C to the hue H is measured (the size of the same brightness L and the chroma saturation C to the hue H is compared) and input data is in the inside of a color reproduction range, When data (L, a, b) is then sent to the interpolating calculation part 203 and input data is in the exterior of a color reproduction range, The hue H refers to the color reproduction range data (the highest chroma saturation C) of said printer corresponding to brightness L' after L conversion on the basis of the brightness corresponding to the highest chroma saturation for every hue of the generating picture device (for example, monitor) used as the target of color matching, saved, It changes into the color (LHC->L'a'b') of the color reproduction range of a printer, and data (L', a', b') is sent to the interpolating calculation part 203. As shown in drawing 3, specifically the data outside a color reproduction range, (every hue) As opposed to the color whose brightness is higher than the brightness corresponding to the highest chroma saturation of the generating picture device (for example, monitor) used as the target of color matching, hue -- it is fixed and brightness becomes high -- it being alike and following -- the brightness from the direction of the color difference minimum -- the direction compressed in the fixed direction according to brightness, [control and] (every hue) As opposed to the color whose brightness is lower than the brightness corresponding to the highest chroma saturation of the generating picture device (for example, monitor) used as the target of color matching, hue -- it is fixed and brightness becomes low -- it being alike and following -- the brightness from the direction of the color difference minimum -- the direction compressed in the fixed direction will be controlled according to brightness, and it will

compress to the color of the color reproduction range of an output unit.

[0007]If the above-mentioned processing is expressed with a formula, it can express as follows.

C'=gamut C (H, L_K)

At the time of L>L_K (L Smax), at the time of L_K=LEmin+(LEmin -Lconst) x(L-LSmax)/(LW-LSmax) L<L_K (LSmax). L_K=Lconst+(Lconst -LEmin) x(LSmax -L)/(LSmax-LB)

However, the hue H with arbitrary gamut C (H, L), the color reproduction range of the output unit (printer) in the brightness L (the highest chroma saturation C)

LSmax : -- brightness LLEmin corresponding to the maximum office chroma saturation of each hue of the generating picture device (monitor) used as the target of color matching : LLconst of the color reproduction range of an input and the output unit (printer) of the color difference minimum : an input and brightness -- L (=L) of the color reproduction range of a fixed output unit (printer)

LW: -- highest brightness LB: of an output unit (printer) -- in the minimum brightness interpolating calculation part 203 of an output unit (printer). In the treating part 204 for C, the treating part 205 for M, the treating part 206 for Y, and the treating part 207 for K, the conversion process by the interpolation which referred to the control signal (peak output value) of the printer in the peak output value storage parts store (ROM2) 202 is carried out, and it is transmitted to an output unit. On the coordinates ($L^*a^*b^*$) on the input space used for interpolating calculation, in that case. The relation of actual input and output (LAB-CMYK) is measured, and the value of C, M, Y, and K to the $L^*a^*b^*$ value computed with the least-squares method etc. using this data is set up beforehand.

[0008]Drawing 4 is a block lineblock diagram of the color correction unit in which a 2nd embodiment of this invention is shown. The color reproduction range storage parts store 401 remembered the color reproduction range day evening (a^*b^* value corresponding to brightness and the maximum chroma saturation to hue) of the printer to be in drawing 4 (ROM1), The highest chroma saturation (brightness) storage parts store which memorized the brightness corresponding to the highest chroma saturation for every hue of a printer in 402 (ROM2), 403 is the peak output value storage parts store (ROM3) which memorized the control signal (C, M, Y, K) of the output unit corresponding to each peak on input color space, these data is determined a priori and each storage parts stores 401, 402, and 403 are made to memorize it. 404 is an interpolation processing section and the control signal C, M, and Y of the printer in the peak output value storage parts store 403 and K are referred to based on an input signal at the time of color correction execution, It consists of the treating part 405 for C which carries out interpolating calculation of C, the treating part 406 for M which carries out interpolating calculation of M, the treating part 407 for Y which carries out interpolating calculation of Y, and

the treating part 408 for K which carries out interpolating calculation of K. Based on the maximum brightness (it becomes a color of paper) and the minimum brightness of a printer, 409 is a lightness converting (L compression) part which carries out compression processing of the brightness ingredient (L^*) of an input picture signal, and 410, After setting a brightness range relatively, it is a convert-colors (compression) part which carries out compression processing to the color in a color reproduction range to a still unreproducible color, and 411 is CPU which controls this whole color correction unit.

[0009]The color correction unit constituted as mentioned above operates as follows. First, in the lightness converting (L compression) part 409 an input picture signal, For example, compression processing of the brightness ingredient (L^*) of the input picture signal which made Lwhite and Lblack the maximum brightness (white point) of a printer and the minimum brightness (black point) is carried out (refer to formula 1). Thus, the lightness value (L^*) of the input picture signal by which brightness compression was carried out in the lightness converting (L compression) part 409 is sent to the convert-colors (compression) part 410 with a chromaticity value (a^*b^*), and is changed into the brightness L, the hue H, and the information on the chroma saturation C (refer to formula 2). the color reproduction range data (the brightness L.) of the printer which the convert-colors (compression) part 410 has in this brightness L, the hue H, and the information and the color reproduction range storage parts store 401 (ROM1) of the chroma saturation C here When the maximum chroma saturation C to the hue H is measured (the size of the same brightness L and the chroma saturation C to the hue H is compared) and input data is in the inside of a color reproduction range, When data (L, a, b) is then sent to the interpolating calculation part 404 and it is outside, The hue H refers to the color reproduction range data (the highest chroma saturation C) of said printer corresponding to brightness L' after L conversion on the basis of the brightness (it memorizes to ROM2) corresponding to the highest chroma saturation for every hue of a monitor and a printer which carries out color matching, saved, It changes into the color (LHC->L'a'b') of the color reproduction range of a printer, and data (L', a', b') is sent to the interpolating calculation part 404.

[0010]As shown in drawing 5, specifically the data outside a color reproduction range, As opposed to the color whose brightness is higher than the brightness (in the case of the monitor L> printer L) corresponding to the highest chroma saturation for every hue of a monitor, hue -- it is fixed and brightness becomes high -- it being alike and following -- the brightness from the direction of the color difference minimum -- extensive **** control being carried out at brightness, and the direction compressed in the fixed direction, (every hue) As opposed to the color whose brightness is lower than the brightness (in the case of the monitor L> printer L) corresponding to the highest chroma saturation of a printer, hue -- it is fixed and brightness

becomes low -- it being alike and following -- the brightness from the direction of the color difference minimum -- the direction compressed in the fixed direction will be controlled according to brightness, and it will compress to the color of the color reproduction range of an output unit. If the above-mentioned processing is expressed with a formula, it can express as follows.

C'=gamut C (H, L_K)

(in the case of LSmon >L-Sprint)

The time of L>LSmon At the time of L_K=LEmin+(LEmin -Lconst) x(L-LSmon)/(LW-LSmon)

LSprint <L<LSmon. It is L_K=Lconst+(Lconst -LEmin) x(LSprint -L)/(LSprint -LB) at the time of

L_K=LEmin L<LSprint.

(in the case of LSmon <LSprint)

It is L_K=LEmin+(LEmin -Lconst) X (L-LSprint)/(LW-LSprint) the time of L>LSprint.

It is L_K=Lconst+(Lconst -LEmin) x(LSmon -L)/(LSmon -LB) at the time of L_K=LEmin L<LSmon

the time of LSmon <L<L-Sprint.

However, the hue H with arbitrary gamut C (H, L). An output unit in the brightness L. color reproduction range (the highest chroma saturation C) of a (printer). LSmon :. [The brightness L corresponding to the highest chroma saturation of each hue of a monitor] LSprint : -- brightness L LEmin corresponding to the highest chroma saturation of each hue of a printer : L Lconst of the color reproduction range of an input and the output unit (printer) of the **** minimum : an input and brightness -- L (=L) of the color reproduction range of a fixed output unit (printer)

LW: The highest brightness of an output unit (printer) LB: The minimum brightness of an output unit (printer) ... (5)

In the interpolating calculation part 404, in the treating part 405 for C, the treating part 406 for M, the treating part 407 for Y, and the treating part 409 for K, the conversion process by the interpolation which referred to the control signal (peak output value) of the printer in the peak output value storage parts store (ROM3) 403 is carried out, and it is transmitted to an output unit.

[0011]

[Effect of the Invention]As explained above, this invention does the following outstanding effects so. In the color converter which changes a control signal in order to take color matching between the color picture output devices from which the size of a color reproduction range differs according to the color correction unit concerning the invention according to claim 1, As opposed to a color unreproducible even if it performs lightness converting processing which sets a brightness range relatively, and lightness converting processing, It is based on the

brightness after the lightness converting processing corresponding to the highest chroma saturation for every hue of the generating picture device used as the target of color matching, Since it constituted so that the color conversion process which controls the direction compressed for every hue according to brightness, and is curtailed to the color in a color reproduction range might be performed, the color correction of crushing of the high saturation corresponding to the characteristic of the generating picture device used as the target of color matching including matching of few color reproduction ranges becomes possible. In the color converter which changes a control signal so that the size and shape of a color reproduction range may take color matching between greatly different color picture output devices according to the color correction unit concerning the invention according to claim 2, As opposed to a color unreproducible even if it performs lightness converting processing which sets a brightness range relatively, and lightness converting processing, It is based on the brightness after the lightness converting processing corresponding to the highest chroma saturation for every hue of the generating picture device of the both sides which do color matching, Since it constituted so that the color conversion process which controls the direction compressed for every hue according to brightness, and is curtailed to the color in a color reproduction range might be performed, color correction including desirable matching of a color reproduction range becomes possible.

[Translation done.]